Importing the necesary libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib as mpl
import seaborn as sns
import matplotlib.ticker as ticker


import warnings
warnings.filterwarnings('ignore')
```

Importing data

In [38]:
```
train = pd.read_csv('C:/Users/Neha/Desktop/portfolio projects05/store_sales pred
test = pd.read_csv('C:/Users/Neha/Desktop/portfolio projects05/store_sales predi
train.head()
```

Out[38]:

	ID	Store_id	Store_Type	Location_Type	Region_Code	Date	Holiday	Discour
0	T1000001	1	S1	L3	R1	01-01-2018	1	Ye
1	T1000002	253	S4	L2	R1	01-01-2018	1	Ye
2	T1000003	252	S3	L2	R1	01-01-2018	1	Ye
3	T1000004	251	S2	L3	R1	01-01-2018	1	Ye
4	T1000005	250	S2	L3	R4	01-01-2018	1	Ye

In [3]:
```
test.head()
```

Out[3]:

	ID	Store_id	Store_Type	Location_Type	Region_Code	Date	Holiday	Discou
0	T1188341	171	S4	L2	R3	2019-06-01	0	N
1	T1188342	172	S1	L1	R1	2019-06-01	0	N
2	T1188343	173	S4	L2	R1	2019-06-01	0	N
3	T1188344	174	S1	L1	R4	2019-06-01	0	N
4	T1188345	170	S1	L1	R2	2019-06-01	0	N

Rename Values

In [4]:
```
# Rename the values on "Discount"
train['Discount'] = train['Discount'].map({'Yes': 1, 'No': 0})
```

Data types

In [39]:
```
print('Data type per variable:')
print(train.dtypes)
```

```
Data type per variable:
ID                object
Store_id           int64
Store_Type        object
Location_Type     object
Region_Code       object
Date              object
Holiday            int64
Discount          object
#Order             int64
Sales            float64
dtype: object
```

In [6]:
```
#debugging
print(train['Date'].head())
```

```
0    01-01-2018
1    01-01-2018
2    01-01-2018
3    01-01-2018
4    01-01-2018
Name: Date, dtype: object
```

Changing data types

In [40]:
```
#train[['Store_id', 'Holiday', 'Discount']] = train[['Store_id', 'Holiday', 'Dis
train['Date'] = pd.to_datetime(train['Date'],format='%d-%m-%Y')
print(train['Date'].dtype)
print(train['Date'].head())
```

```
datetime64[ns]
0   2018-01-01
1   2018-01-01
2   2018-01-01
3   2018-01-01
4   2018-01-01
Name: Date, dtype: datetime64[ns]
```

finding errors and duplicates

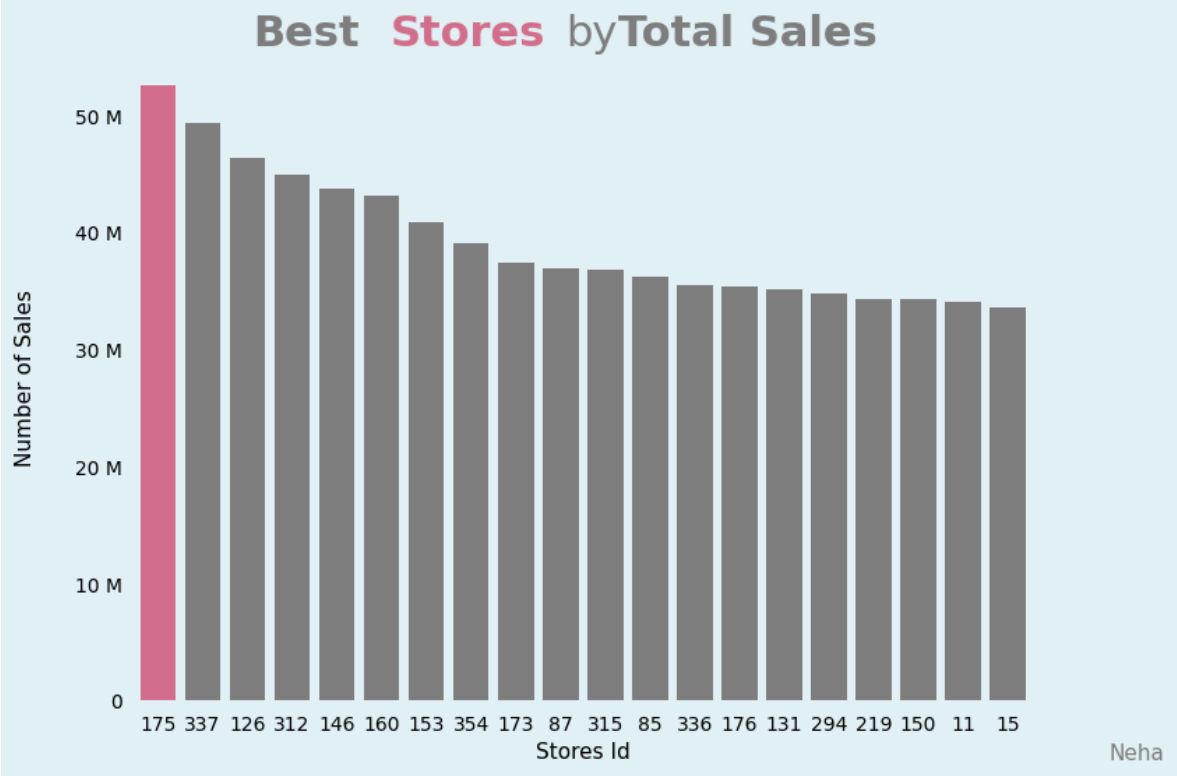
In [8]:
```
# Do we have duplicates?
print('Number of duplicates:', len(train[train.duplicated()]))

# Do we have missing values?
print('Number of missing values:', train.isnull().sum().sum())
```

```
Number of duplicates: 0
Number of missing values: 0
```

Best stores by total sales

In [14]:
```
plt.rcParams['font.family'] = 'sans-serif'
# Which are the best stores (by number of sells)?
best_stores = train.groupby(['Store_id'], as_index=False)['Sales'].sum()
best_stores = best_stores.sort_values('Sales', ascending = False)
best_stores = best_stores.head(20)
best_stores['Store_id'] = best_stores['Store_id'].astype(str)

# Visualization
fig, ax = plt.subplots(figsize =(9, 6))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

# For changing colors
col1 = best_stores.head(1)
col2 = best_stores.tail(19)

ax.bar(col1.Store_id, col1.Sales, color = '#d4728c')
ax.bar(col2.Store_id, col2.Sales, color = 'grey')

# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')

# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)

# Setting thousands with k
ax.yaxis.set_major_formatter(ticker.EngFormatter())
```

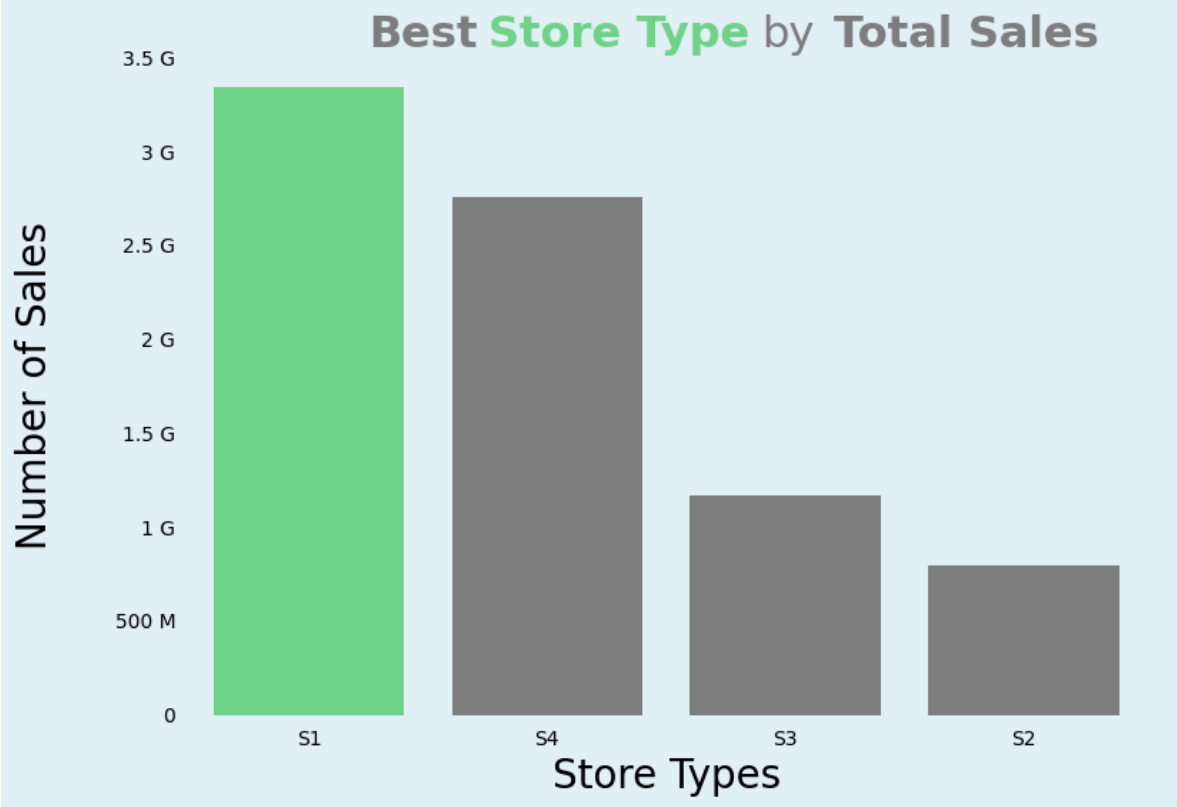
```
# Y axis position
ax.spines['left'].set_position(('data', -0.5))

# Labels titles
plt.xlabel('Stores Id', fontsize=11)
plt.ylabel('Number of Sales', fontsize=11, labelpad=20)

# Title
plt.text(2.1, 56000000, "Best", size=22, color="grey", fontweight="bold")
plt.text(5.2, 56000000, "Stores", size=22, color="#d4728c", fontweight="bold")
plt.text(9.1, 56000000, "by", size=22, color="grey")
plt.text(10.3, 56000000,"Total Sales", size=22, color="grey", fontweight="bold")

# Author
plt.text(22.5, -5000000, "Neha", fontsize=11, ha="right", color='grey');
```



Best Stores types by total sales

In [15]:
```
plt.rcParams['font.family'] = 'sans-serif'

# Which are the best store types (by number of sales)?
best_store_type = train.groupby(['Store_Type'], as_index=False)['Sales'].sum()
best_store_type = best_store_type.sort_values('Sales', ascending = False)
best_stores = best_stores.head()
best_store_type['Store_Type'] = best_store_type['Store_Type'].astype(str)


# Visualization
fig, ax = plt.subplots(figsize =(9,6))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

# For changing colors
col1 = best_store_type.head(1)
```

```
col2 = best_store_type.tail(3)

ax.bar(col1.Store_Type, col1.Sales, color = '#72d489')
ax.bar(col2.Store_Type, col2.Sales, color = 'grey')

# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')

# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)
# Setting thousands with k
import matplotlib.ticker as ticker  # Ensure this import exists
ax.yaxis.set_major_formatter(ticker.EngFormatter())

# Y axis position
ax.spines['left'].set_position(('data', -0.5))

# Labels titles
plt.xlabel('Store Types', fontsize=20)
plt.ylabel('Number of Sales', fontsize=20, labelpad=30)

# Title
plt.text(0.25, 3555000000, "Best", size=22, color="grey", fontweight="bold")
plt.text(0.75, 3555000000, "Store Type", size=22, color="#72d489", fontweight="b
plt.text(1.90, 3555000000, "by", size=22, color="grey")
plt.text(2.2, 3555000000,"Total Sales", size=22, color="grey", fontweight="bold"

plt.show()
```



Best months by total sales

In [16]:
```
plt.rcParams['font.family'] = 'sans-serif'
# Best months by sells
best_month = train.copy()
best_month['Month'] = best_month['Date'].apply(lambda x: x.strftime('%b-%Y'))
best_month = best_month.groupby(['Month'], as_index=False)['Sales'].sum()

# Visualization
fig, ax = plt.subplots(figsize =(9, 6))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

best_month_1 = best_month.sort_values('Sales', ascending = False).head(1)

ax.plot(best_month.Month, best_month.Sales, marker='o', markerfacecolor='grey',
ax.plot(best_month_1.Month, best_month_1.Sales, marker='o', markerfacecolor='#54

plt.xticks(rotation=30)

# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')

# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)
# Setting thousands with k
ax.yaxis.set_major_formatter(ticker.EngFormatter())

# Labels titles
plt.ylabel('Number of Sales', fontsize=11, labelpad=20)

# Annotations
plt.text(13.4, 573000000, "May 2019 has been", size=10)
plt.text(13.4, 566000000, "the best month so far!", size=10)


# Title
plt.text(2.5, 582000000, "Best", size=22, color="grey", fontweight="bold")
plt.text(4.5, 582000000, "Months", size=22, color="#5495c9", fontweight="bold")
plt.text(7.8, 582000000, "by", size=22, color="grey")
plt.text(8.8, 582000000,"Total Sales", size=22, color="grey", fontweight="bold")
```

Out[16]:
```
Text(8.8, 582000000, 'Total Sales')
```

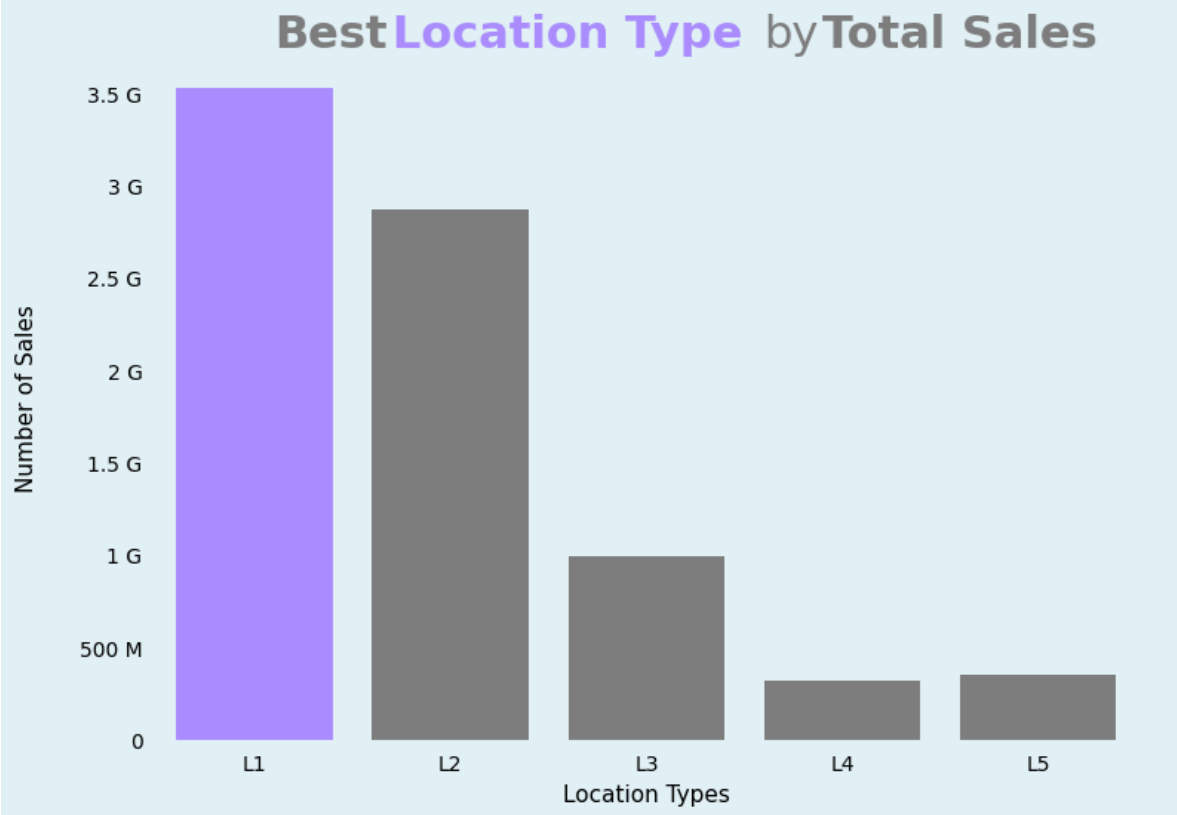
Best location type by total sales

In [17]:

```
plt.rcParams['font.family'] = 'sans-serif'
# Which are the best locations (by number of sales)?
best_location = train.groupby(['Location_Type'], as_index=False)['Sales'].sum()
best_location['Location_Type'] = best_location['Location_Type'].astype(str)

# Visualization
fig, ax = plt.subplots(figsize =(9, 6))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

# For changing colors
col1 = best_location.head(1)
col2 = best_location.tail(4)

ax.bar(col1.Location_Type, col1.Sales, color = '#ab90ff')
ax.bar(col2.Location_Type, col2.Sales, color = 'grey')

# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')

# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)
# Setting thousands with k
ax.yaxis.set_major_formatter(ticker.EngFormatter())

# Y axis position
ax.spines['left'].set_position(('data', -0.5))

# Labels titles
```

```
plt.xlabel('Location Types', fontsize=11)
plt.ylabel('Number of Sales', fontsize=11, labelpad=20)

# Title
plt.text(0.10, 3750000000, "Best", size=22, color="grey", fontweight="bold")
plt.text(0.70, 3750000000, "Location Type", size=22, color="#ab90ff", fontweight
plt.text(2.6, 3750000000, "by", size=22, color="grey")
plt.text(2.9, 3750000000,"Total Sales", size=22, color="grey", fontweight="bold"
```

Out[17]: Text(2.9, 3750000000, 'Total Sales')

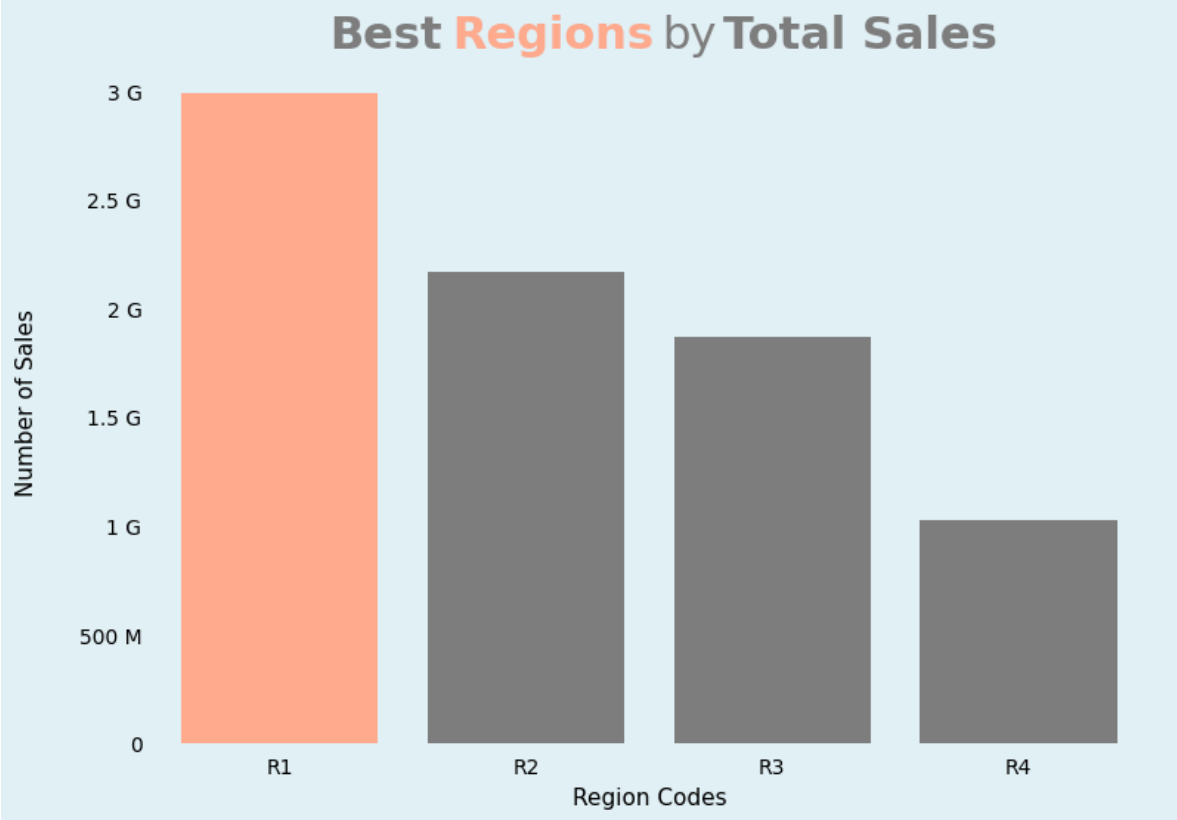


Best regions by total sales

In [18]:
```
# Which are the best regions (by number of sales)?
best_region = train.groupby(['Region_Code'], as_index=False)['Sales'].sum()
best_region['Region_Code'] = best_region['Region_Code'].astype(str)

# Visualization
fig, ax = plt.subplots(figsize =(9, 6))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

# For changing colors
col1 = best_region.head(1)
col2 = best_region.tail(3)

ax.bar(col1.Region_Code, col1.Sales, color = '#ffab90')
ax.bar(col2.Region_Code, col2.Sales, color = 'grey')

# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')
```

```
# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)

# Setting thousands with k
ax.yaxis.set_major_formatter(ticker.EngFormatter())
# Y axis position
ax.spines['left'].set_position(('data', -0.5))

# Labels titles
plt.xlabel('Region Codes', fontsize=11)
plt.ylabel('Number of Sales', fontsize=11, labelpad=20)

# Title
plt.text(0.2, 3200000000, "Best", size=22, color="grey", fontweight="bold")
plt.text(0.70, 3200000000, "Regions", size=22, color="#ffab90", fontweight="bold
plt.text(1.55, 3200000000, "by", size=22, color="grey")
plt.text(1.80, 3200000000,"Total Sales", size=22, color="grey", fontweight="bold
```

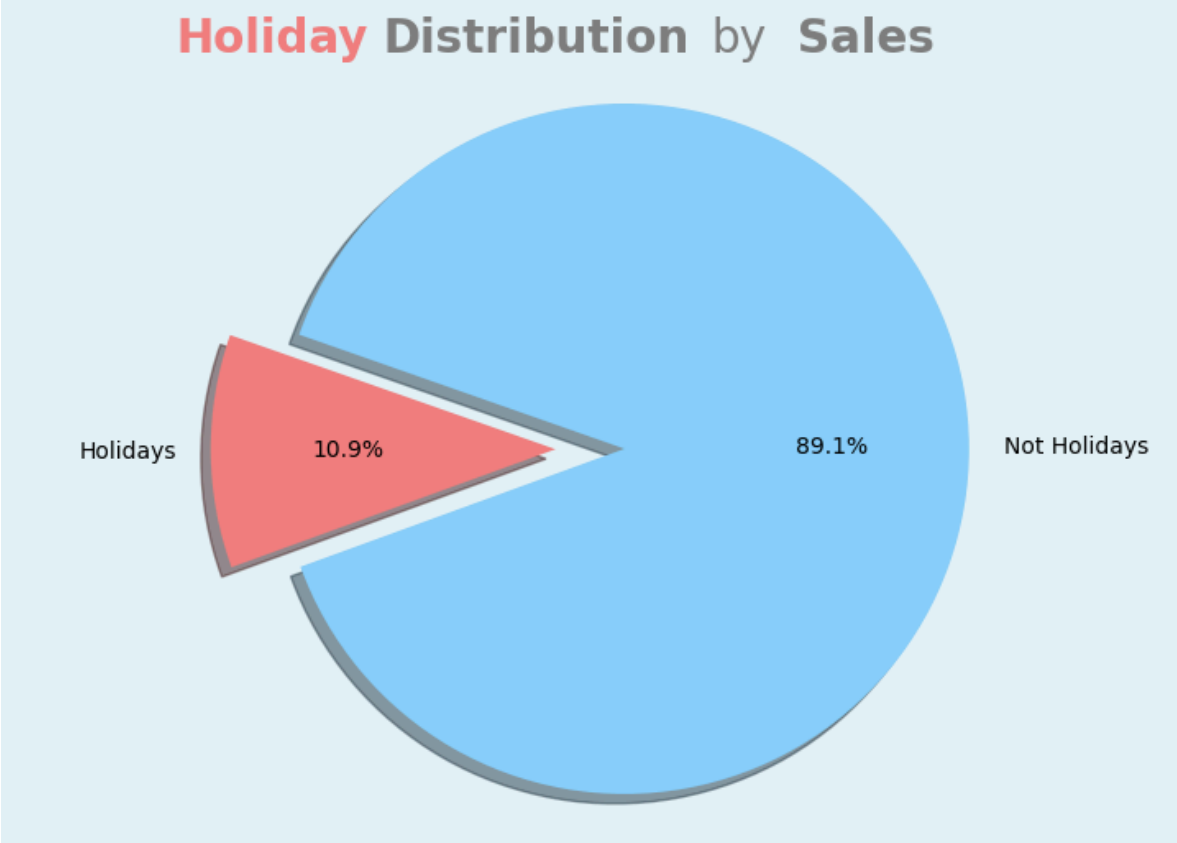
Out[18]: Text(1.8, 3200000000, 'Total Sales')



Holiday distribution by sales

In [19]:
```
plt.rcParams['font.family'] = 'sans-serif'
# Holidays Distribution
holiday = train.groupby(['Holiday'], as_index=False)['Sales'].sum()
holiday['Holiday'] = holiday['Holiday'].astype(str)

# Visualization
fig = plt.figure(figsize =(9, 6))
fig.patch.set_facecolor('#e4f2f7')

plt.pie(holiday['Sales'],
```

```
        explode=(0.2, 0),
        labels=['Not Holidays', 'Holidays'],
        colors= ['lightskyblue', 'lightcoral'],
        autopct='%1.1f%%',
        shadow=True,
        startangle=200)

plt.axis('equal')

plt.text(-1.10, 1.15, "Holiday", size=20, color="lightcoral", fontweight="bold")
plt.text(-0.50, 1.15, "Distribution", size=20, color="grey", fontweight="bold")
plt.text(0.45, 1.15, "by", size=20, color="grey")
plt.text(0.70, 1.15, "Sales", size=20, color="grey", fontweight="bold")

plt.show()
```

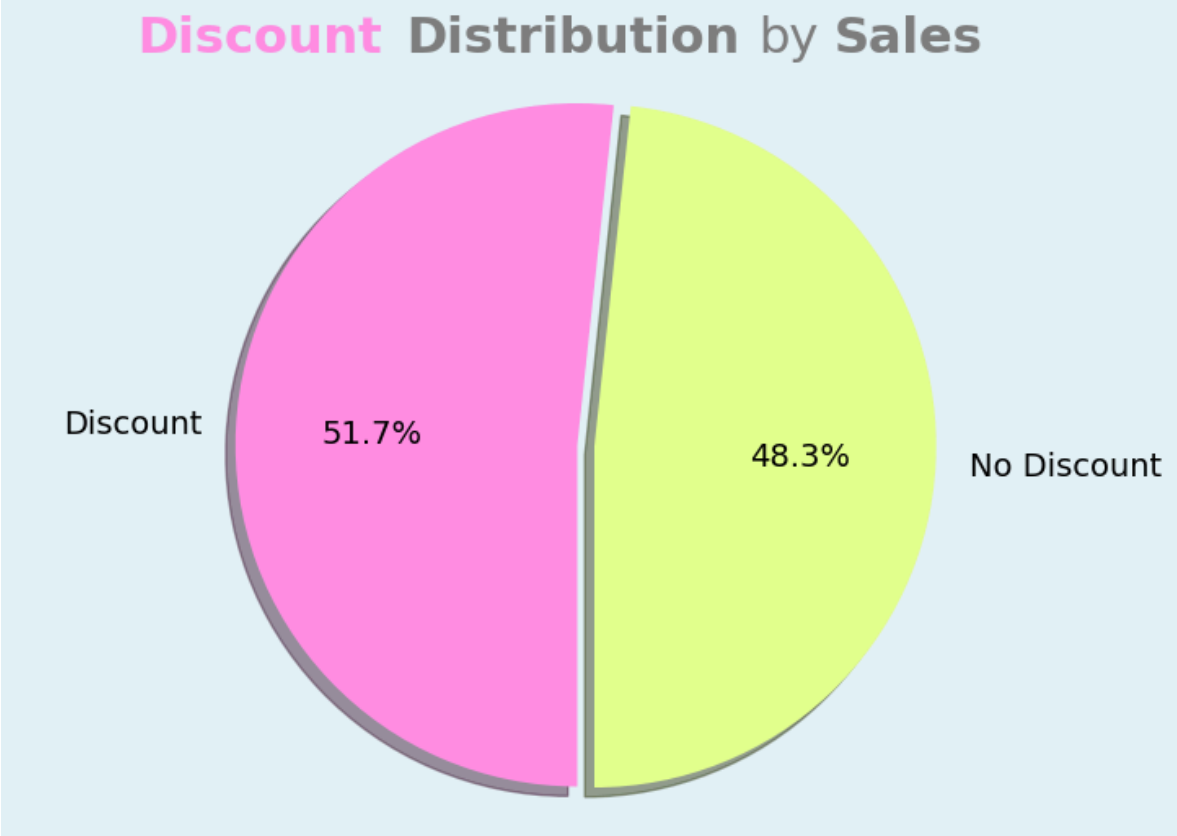


Discount distribution by sales

In [20]:

```
plt.rcParams['font.family'] = 'sans-serif'
# Discount distribution
discount = train.groupby(['Discount'], as_index=False)['Sales'].sum()
discount['Discount'] = discount['Discount'].astype(str)
discount.head()

# Visualization
fig = plt.figure(figsize =(9, 6))
fig.patch.set_facecolor('#e4f2f7')

mpl.rcParams['font.size'] = 14

plt.pie(discount['Sales'],
        labels=['No Discount', 'Discount'],
```

```
        explode=(0.05, 0),
        colors= ['#e4ff90', '#ff90e4'],
        autopct='%1.1f%%',
        shadow=True,
        startangle=270)

plt.axis('equal')

plt.text(-1.29, 1.15, "Discount", size=22, color="#ff90e4", fontweight="bold")
plt.text(-0.50, 1.15, "Distribution", size=22, color="grey", fontweight="bold")
plt.text(0.53, 1.15, "by", size=22, color="grey")
plt.text(0.75, 1.15, "Sales", size=22, color="grey", fontweight="bold")

plt.show()
```



In [21]:
```
# Let's check the data again
train.head()
```

Out[21]:

	ID	Store_id	Store_Type	Location_Type	Region_Code	Date	Holiday	Discou
0	T1000001	1	S1	L3	R1	2018-01-01	1	
1	T1000002	253	S4	L2	R1	2018-01-01	1	
2	T1000003	252	S3	L2	R1	2018-01-01	1	
3	T1000004	251	S2	L3	R1	2018-01-01	1	
4	T1000005	250	S2	L3	R4	2018-01-01	1	

In [22]:
```
# Remove "ID"
train.drop('ID', axis=1, inplace=True)
```

In [23]:
```
# Data types
print('Data type per variable:')
print(train.dtypes)
```

```
Data type per variable:
Store_id                   int64
Store_Type                object
Location_Type             object
Region_Code               object
Date              datetime64[ns]
Holiday                    int64
Discount                   int64
#Order                     int64
Sales                    float64
dtype: object
```

In [24]:
```
train[['Store_id','Holiday', 'Discount']] = train[['Store_id', 'Holiday', 'Disco
```

In [25]:
```
categ_cols = train.dtypes[train.dtypes == object]
categ_cols = categ_cols.index.tolist()
train = pd.get_dummies(train, columns=categ_cols, drop_first=True)
```

In [26]:
```
train['Year'] = train['Date'].dt.year
train['Month'] = train['Date'].dt.month
train['Day_of_week'] = train['Date'].dt.dayofweek
train['Weekday'] = train['Date'].dt.weekday
train['Quarter'] = train['Date'].dt.quarter

train = train.drop(['Date'], axis = 1)

train = pd.get_dummies(train, columns=['Year'], drop_first=True, prefix='Year')
train = pd.get_dummies(train, columns=['Month'], drop_first=True, prefix='Month'
train = pd.get_dummies(train, columns=['Day_of_week'], drop_first=True, prefix='
train = pd.get_dummies(train, columns=['Weekday'], drop_first=True, prefix='Week
train = pd.get_dummies(train, columns=['Quarter'], drop_first=True, prefix='Quar

train.head()
```

Out[26]:

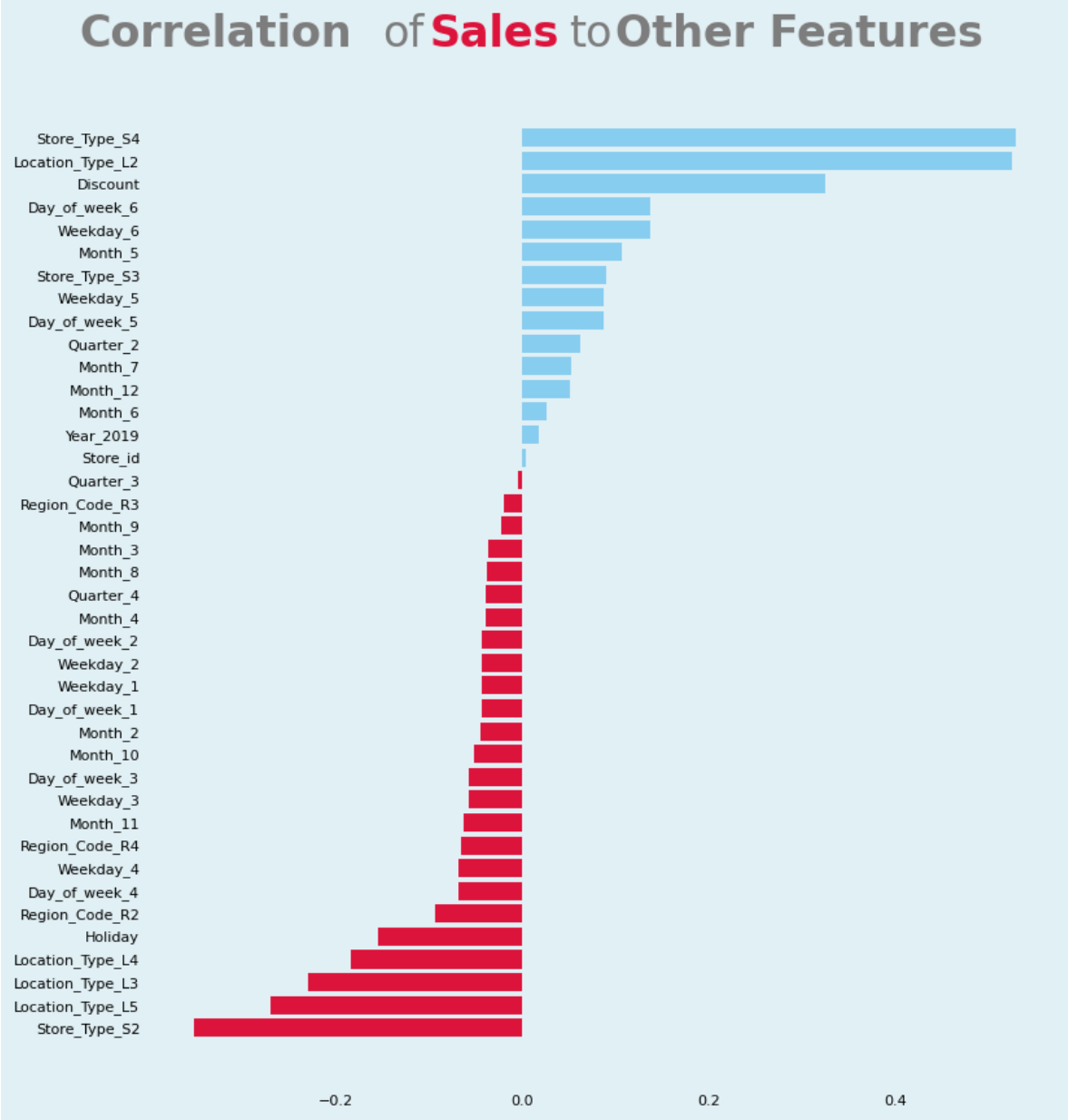
	Store_id	Holiday	Discount	#Order	Sales	Store_Type_S2	Store_Type_S3	Store_
0	1	1	1	9	7011.84	False	False	
1	253	1	1	60	51789.12	False	False	
2	252	1	1	42	36868.20	False	True	
3	251	1	1	23	19715.16	True	False	
4	250	1	1	62	45614.52	True	False	

5 rows × 42 columns

Correlation of sales with other features

In [27]:

```
plt.rcParams['font.family'] = 'sans-serif'
corr = train[train.columns].corr()['Sales'][:].sort_values(ascending=True).to_fr
corr = corr.drop(corr[corr.Sales > 0.90].index)

# Visualization
fig, ax = plt.subplots(figsize =(9, 10))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

ax.barh(corr.index, corr.Sales, align='center', color = np.where(corr['Sales'] <

ax.tick_params(axis='both', which='major', labelsize=8)
ax.yaxis.set_label_coords(0, 0)

# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')

# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)

plt.text(-0.475, 43, "Correlation", size=24, color="grey", fontweight="bold");
plt.text(-0.150, 43, "of", size=24, color="grey");
plt.text(-0.100, 43, "Sales", size=24, color="crimson", fontweight="bold");
plt.text(0.05, 43, "to", size=24, color="grey");
plt.text(0.10, 43, "Other Features", size=24, color="grey", fontweight="bold");
```



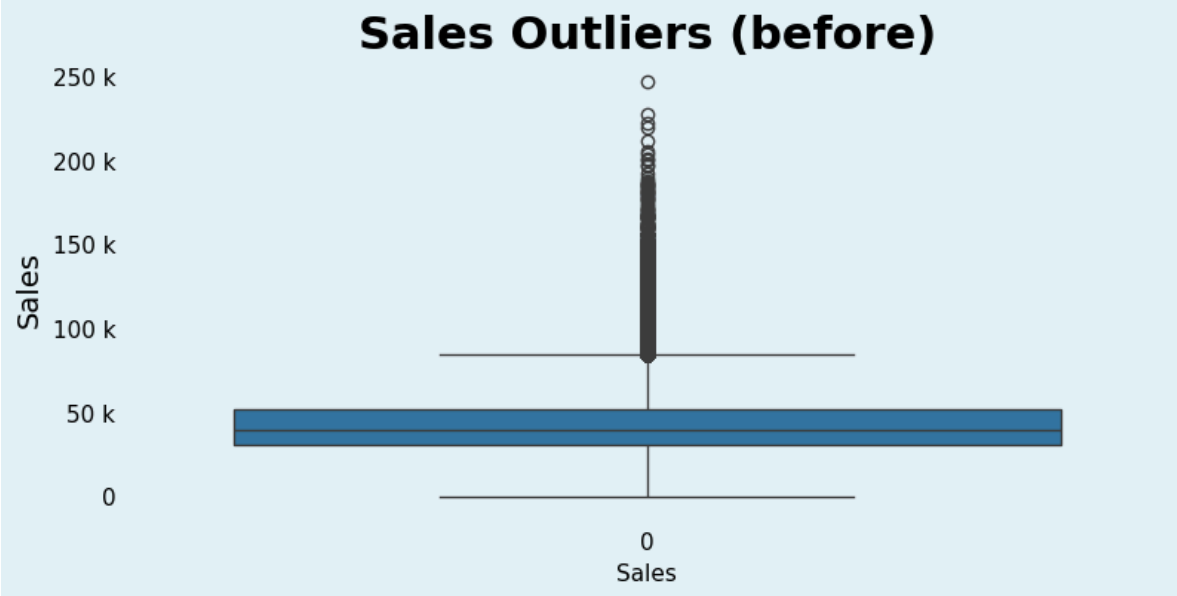
In [28]:
```
del train['Store_id']
del train['Year_2019']
```

In [29]:
```
train['holiday_and_discount'] = train['Holiday'] * train['Discount']
```

Sales Outliers (before)

In [30]:
```
plt.rcParams['font.family'] = 'sans-serif'
# Visualization
fig, ax = plt.subplots(figsize =(9, 4))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

sns.boxplot(train.Sales);

ax.tick_params(axis='both', which='major', labelsize=11)

# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')
```

```
# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)

# Setting thousands with k
ax.yaxis.set_major_formatter(ticker.EngFormatter())
ax.xaxis.set_major_formatter(ticker.EngFormatter())

# Y axis position
ax.spines['left'].set_position(('data', -0.5))

plt.xlabel('Sales', fontsize=11);

plt.title('Sales Outliers (before)', size=22, fontweight="bold");
```



Sales Outliers (After)

In [35]:
```
# Dealing with the outliers
q1 = train['Sales'].quantile(0.25)
q3 = train['Sales'].quantile(0.75)
iqr = q3-q1
Lower_tail = q1 - 1.5 * iqr
Upper_tail = q3 + 1.5 * iqr
med = np.median(train['Sales'])
for i in train['Sales']:
    if i > Upper_tail or i < Lower_tail:
            train['Sales'] = train['Sales'].replace(i, med)
```

In [37]:
```
plt.rcParams['font.family'] = 'sans-serif'
# Visualization
fig, ax = plt.subplots(figsize =(9, 4))
fig.patch.set_facecolor('#e4f2f7')
ax.patch.set_facecolor('#e4f2f7')

sns.boxplot(train['Sales']);

ax.tick_params(axis='both', which='major', labelsize=11)
```

```
# Remove ticks
ax.xaxis.set_ticks_position('none')
ax.yaxis.set_ticks_position('none')

# Remove axes splines
for i in ['top', 'bottom', 'left', 'right']:
    ax.spines[i].set_visible(False)

# Setting thousands with k
ax.yaxis.set_major_formatter(ticker.EngFormatter())
ax.xaxis.set_major_formatter(ticker.EngFormatter())

# Y axis position
ax.spines['left'].set_position(('data', -0.5))

# Font
mpl.rcParams['font.family'] = 'Source Sans Pro'

plt.xlabel('Sales', fontsize=11);
plt.title('Sales Outliers (After)', size=22, fontweight="bold");
```

In [ ]: